

REMARKS:

- 1) Referring to item 4) of the Office Action Summary, please note that prior claim 37 had been amended to be directed to the elected product invention rather than the non-elected method invention. Thus, claim 37 should not have been withdrawn from consideration, but rather should have been examined. In any event, claim 37 has now been canceled and replaced by new claim 45, which is also directed to the elected product invention. Thus, entry and consideration of new claim 45 are requested.
- 2) Referring to item 10) of the Office Action Summary, please indicate the acceptance of the drawings filed on April 13, 2006.
- 3) In the acknowledgment copy of applicants' IDS Form PTO-1449 of April 13, 2006 enclosed with the Office Action, the Examiner has not initialed, but rather has crossed out, references AF and AG. In section 2 on page 2 of the Office Action, the Examiner indicated that these references were not considered "*because copies of the documents were not provided*". Because those references AF and AG had been cited in the International Search Report of this PCT Application, copies thereof should have been transmitted to the USPTO by the International Searching Authority in the international processing of this PCT Application. See MPEP 1893.03(g). Furthermore, because those references were not indicated as having been received by the USPTO in the Notice of Acceptance of Application issued on March 19, 2007, applicants filed a Supplemental IDS on March 27, 2008 enclosing copies of

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references AF and AG. According to our return receipt postcard, that Supplemental IDS including copies of references AF and AG was received in the USPTO on March 21, 2008. Therefore, please consider references AF and AG, and return a fully initialed, signed and dated copy of IDS Form PTO-1449 of April 13, 2006.

4) The claims have been amended as follows.

Independent claim 25 has been amended to be directed to an intermediate product, namely a semi-fabricated intermediate article for producing a composite material, rather than the composite material as a finished product. In this regard, claim 25 further incorporates features from claim 41, namely that this semi-fabricated intermediate article comprises a plurality of discs that are arranged as a loose stack of discs that are not yet joined to one another. Further it has been made clear that the at least one reinforcing fiber being embedded in the groove in the respective disc means that the matrix material of the disc is surrounding and consolidated around the at least one reinforcing fiber in the groove. This is supported in the original disclosure, for example in the specification at page 7 lines 1 to 15, page 10 lines 4 to 11, and the drawings in Figs. 3 to 5.

The preamble of the dependent claims has been amended for conformance with amended independent claim 25.

Claim 37 has been canceled to avoid confusion resulting from an elected product claim included between successive non-elected method claims.

Independent claim 40 has been amended to make clear that the at least one reinforcing fiber is embedded in and surrounded by the matrix material that is consolidated around the at least one reinforcing fiber. This feature is supported in the original disclosure similarly as discussed above in connection with the amendment of claim 25.

Claim 42 has been amended to make clear that a product feature rather than a process step is being claimed. Namely, in amended claim 42, the discs are joined to one another in the stack by diffusion weld joints along the annular surfaces of successive neighboring ones of the discs. Such a diffusion weld joint is an existing physical feature of the resulting structure and it has characteristics indicative of having been formed by diffusion welding.

Claim 43 has been amended to recite that at least four successive neighboring discs in the stack are involved in the alternating larger and smaller outer diameters of the fiber-reinforced intermediate ring sections, as shown in Figs. 6 and 8 of the present application. This makes clear that the claimed arrangement is truly a successive alternating arrangement of larger and smaller outer diameters of the fiber-reinforced ring sections.

New claim 45 is based on prior claim 37 directed to the elected product invention, with at least four successive neighboring discs in the stack having alternating different outward radial dimensions of the grooves in alternating succession in the at least four successive neighboring discs, so that the fiber-reinforced disc ring sections intermesh with the

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fiber-free disc ring sections. This is further supported by Figs. 6 and 8 of the present application.

New independent claim 46 is based on subject matter from prior claim 25 and from new claim 45.

In view of the above mentioned original support, the claim amendments and the new claims do not introduce any new matter. Entry and consideration thereof are respectfully requested.

- 5) Referring to section 1 on page 2 of the Office Action, the election of the Group I product claims is hereby affirmed. After the present amendments, claims 25 to 31 and 40 to 46 are directed to and read on the elected product invention. Prior elected claim 37 has been canceled. Withdrawn non-elected method claims 32 to 36, 38 and 39 depend from elected claim 25 and are directed to a method-of-making the elected product of claim 25. If the elected product claims are ultimately found allowable, the Examiner is respectfully requested to rejoin, consider and allow the dependent method-of-making claims in accordance with MPEP 821.04 and 2116.01.
- 6) In section 3 on page 2 of the Office Action, the Examiner objects to the disclosure because "*the references to the canceled claims on page 3 must be canceled*". Please note that the specification was already amended in that manner in the Response filed on February 15, 2008. Please make sure that the specification amendments of the Response of February 15, 2008 are entered in the official record, and please withdraw the objection.

- 7) Referring to section 4 on page 2 of the Office Action, the objection to claims 25 and 30 because the terms "portion" and "section" allegedly appear to be used interchangeably, is respectfully traversed. In claims 25 and 30, the "disc ring portion" refers to the disc-shaped or annular portion of the disc surrounding an inner opening and surrounded by an outer disc edge of the disc. On the other hand, this disc ring portion includes three disc ring sections with different characteristics. Namely, the disc ring portion includes an inner first disc ring section and an outer second disc ring section that are each free of reinforcing fiber, and a fiber-reinforced disc ring section that is reinforced with at least one fiber and that is positioned between the first and second disc ring sections. Thus, the terms "portion" and "section" are not used interchangeably, but rather have different meanings that are defined in the claims and used consistently throughout the claims. Thus, please withdraw the objection to claims 25 and 30.
- 8) Referring to section 5 on pages 2 and 3 of the Office Action, the rejection of claim 41 as indefinite under 35 USC 112(2) is respectfully traversed. The Examiner asserted that "claim 40 defines the product as being consolidated". That is a misinterpretation of claim 40. Instead, claim 40 is directed to an article that comprises a plurality of annular ring-shaped composite discs arranged in a stack. Claim 40 recites that each respective disc is consolidated, but does not recite or require that the overall product (e.g. the stack of such consolidated discs) is consolidated. In other words, in

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claim 40, each disc is consolidated, but the discs may or may not be joined together in the stack. Dependent claim 41 recites that the discs are only loosely stacked in the stack and are not yet joined to one another, while dependent claim 42 recites the other option namely that the discs are joined to one another in the stack. Thus, there is no ambiguity. For the above reasons, please withdraw the rejection of claim 41.

- 9) Referring to section 7 on pages 3 and 4 of the Office Action, the rejection of claims 25, 27, 31, 40 to 42 and 44 as anticipated by US Patent 6,916,550 (Ress et al. 550) is respectfully traversed.

This rejection will be discussed respectively in connection with each of the independent claims 25, 40 and 46.

Independent claim 25 is directed to a semi-fabricated intermediate article for producing a composite material. This semi-fabricated intermediate article comprises a plurality of discs arranged as a loose stack of these discs which are not yet joined to one another. Each disc comprises a matrix material and at least one reinforcing fiber embedded in a groove in the matrix material. Particularly, the reinforcing fiber is embedded with the matrix material surrounding and consolidated around the reinforcing fiber in the groove.

The above features highlight an important aspect of the present invention, namely that each disc itself is already consolidated so that the consolidated matrix material of the disc surrounds the reinforcing fiber embedded in the groove. This can be seen, for example, in Figs. 3, 4 and 5 of this application,

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and is described in the specification at page 6 lines 1 to 4, page 7 lines 1 to 23 and page 10 lines 4 to 11. This aspect of the invention achieves several advantages. First, by consolidating each disc to surround the reinforcing fiber with consolidated matrix material as the fiber is embedded in the groove, this ensures that the fiber will be accurately and precisely positioned as intended within the individual disc. Secondly, the complexity and the required processing conditions for compacting each disc individually before assembly of the stack, rather than compacting and consolidating the entire stack as a whole, can be simplified. Thirdly, after consolidating each individual disc, the consolidated discs can be inspected for cracks or breaks in the matrix material or in the reinforcing fiber, so that any individual defective disc can be discarded before assembling the stack of discs. This is advantageous compared to prior art in which a consolidation defect would only be discovered after assembly and consolidation of the entire stack, so that it would be necessary to discard the entire stack rather than only an individual defective disc.

The prior art does not disclose and would not have suggested a semi-fabricated intermediate article involving a loose stack of such pre-consolidated discs which are not yet joined to one another but which have the reinforcing fiber embedded in the groove with the matrix material surrounding and consolidated around the fiber in the groove in each respective disc.

Ress et al. 550 discloses a metal matrix composite structure and a method of manufacturing the same. According to Ress et al. 550, a plurality of sheets (32) of metal, metallic alloy, or

intermetallic material are provided with grooves (34) to receive reinforcing fibers (36), the sheets are stacked with the fibers therebetween, and then the entire stack of separate sheets and fibers is consolidated to form the integral metal matrix composite structure (see Figs. 3, 3A and 4; and col. 4 lines 1 to 32). So, Ress et al. 550 disclose a semi-fabricated intermediate article comprising a loose stack of sheets with reinforcing fibers loosely and partially received in grooves, as shown in Fig. 3A. However, in that loosely stacked condition, the matrix material is not surrounding and consolidated around the reinforcing fibers. Instead, the matrix material is only consolidated around the reinforcing fibers so as to surround the fibers in the finished consolidated stack structure as shown in Fig. 4. Thus, Ress et al. 550 does not anticipate present claim 25.

Present claim 25 also would not have been obvious, because Ress et al. 550 would have provided no teaching, suggestion or motivation, or any common sense knowledge, to have consolidated each disc individually so that the fiber is embedded in the groove with the matrix material surrounding and consolidated around the fiber, before the entire stack is consolidated together. There is no proposal of such a semi-fabricated intermediate article whatsoever. In fact, it would not even have been possible, because the grooves are not deep enough for the matrix material in each individual sheet to surround and be consolidated around the fiber in the groove. Namely, Ress et al. 550 rely on the next neighboring sheet or disc of matrix material

to surround or enclose the fibers between successive sheets or discs when the entire stack is consolidated (see Figs. 3, 3A, 4).

The claims depending from claim 25 are patentable over the prior art already due to their dependence. New dependent claim 45 additionally recites that at least four successive neighboring discs respectively have different outward radial dimensions of the groove in alternating succession in these successive neighboring discs. Such an arrangement is exemplified in present Figs. 6 and 8, where a truly alternating intermeshing of the fiber-free outer section and the fiber-reinforced middle section can clearly be seen. The Examiner has referred to Fig. 8 of the reference for disclosing a staggered arrangement of the grooves. Nonetheless, if each disc or sheet in the stack has such a structure, there would still not be alternating different outer diameters of the grooved section in successive adjacent discs.

Present independent claim 40 is directed to a composite material article that comprises a plurality of annular ring-shaped composite discs stacked successively to form a stack of these discs. Each disc includes an annular ring of matrix material and at least one reinforcing fiber arranged in the matrix material in an intermediate ring portion thereof. Each disc is bounded by first and second annular surfaces, and the at least one reinforcing fiber is embedded in and surrounded by the matrix material that is consolidated around the reinforcing fiber so that the reinforcing fiber is located between and axially displaced away from the first and second annular surfaces. In other words, in each respective individual disc, the reinforcing fiber is buried and embedded in and surrounded by the matrix

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material, within the thickness of the disc. This is achieved, as recited in claim 40, as a result of a fabrication process in which a groove deeper than a diameter of the reinforcing fiber was provided in the matrix material of the disc, the fiber was disposed in the groove, and the disc was consolidated to deform the matrix material thereof so as to close the groove around the fiber. The resulting structure is shown, for example, in Figs. 4 and 5 of the present application. The prior art does not disclose and would not have suggested such a structure of stacked discs, in which each disc has a reinforcing fiber embedded in and surrounded by matrix material that is consolidated around the fiber so that the fiber is located between and axially displaced away from the major surfaces of the disc.

As discussed above, Ress et al. 550 disclose a stacked structure with unconsolidated discs or sheets alternating with fibers (see Figs. 3 and 3A of the reference), but in that arrangement, the fibers are not embedded in and surrounded by the matrix material, and the matrix material has not yet been consolidated around the fibers. As a result, the fibers are not located between and axially displaced inwardly away from the annular surfaces of each disc. On the other hand, in the final consolidated stack according to Fig. 4 of the reference, the successive discs are melded together, and the respective reinforcing fiber is still not located between and axially displaced inwardly away from the annular surfaces of a respective disc, but rather is still located at a junction area between successive discs (compare Figs. 3A and 4). Thus, Ress et al. 550 do not anticipate present independent claim 40.

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Claim 40 also would not have been obvious, because the reference would not have provided any teaching, suggestion, motivation or common sense knowledge toward the features of present claim 40 as discussed above. The arrangement of sheets and fibers according to Ress et al. 550, and the processing method disclosed by Ress et al. 550 cannot result in the structure of stacked discs as recited in present claim 40.

New independent claim 46 recites features from prior claims 25 and 37. Particularly, claim 46 is directed to a composite material with reinforcing fibers received in grooves in discs of matrix material, wherein the grooves in at least four successive discs in the stack respectively extend to two different outward radial dimensions in alternating succession in the successive neighboring discs. This alternating different outward radial dimension of the fiber-receiving groove results in an intermeshing of the outer fiber-free ring sections with the fiber-reinforced ring sections of the successive neighboring discs. Claim 46 recites at least four of such successive neighboring discs with alternating outer dimensions of the fiber-receiving groove, to make clear that a true alternation is intended, for example as shown in present Figs. 6 and 8. The prior art would not have disclosed and would not have suggested such an arrangement.

Ress et al. 550 disclose an arrangement as discussed above. The Examiner has pointed out the staggered groove arrangement in the disc or sheet according to Fig. 8 of the reference. However, even such a staggered arrangement for each sheet or disc would not have resulted in or suggested an alternation of different

outward diameters of the fiber-receiving groove in successive discs in the stack. Thus, Ress et al. 550 does not disclose and would not have suggested the intermeshing as recited in present claim 46 and exemplified in present Figs. 6 and 8.

For the above reasons, the Examiner is respectfully requested to withdraw the rejection of claims 25, 27, 31, 40 to 42 and 44 as anticipated by Ress et al. 550.

- 10) Referring to section 8 on page 4 of the Office Action, the rejection of claims 25, 27, 31 and 40 to 44 as anticipated by US Patent 6,261,699 (Ress et al. 699) is respectfully traversed.

Independent claims 25, 40 and 46 have been discussed above in comparison to US Patent 6,916,550 (Ress et al. 550). The disclosure of Ress et al. 699 is similar to that of Ress et al. 550, but Ress et al. 699 additionally disclose embodiments in which fibers appear to be staggered (e.g. Fig. 12). However, just like in Ress et al. 550, Ress et al. 699 also disclose only to arrange alternating loose layers of fibers and sheets of matrix material in alternating succession in a loose stack, which is then consolidated to form the final composite structure (see Figs. 6, 7 and 8). Fig. 9 additionally discloses a stack of tape layers formed by depositing a magnetic alloy powder around fibers and subsequent drying, and stacking between top and bottom matrix members. Fig. 10 discloses a stacked arrangement of magnetic alloy wires and fibers between matrix material top and bottom members. All of these arrangements would not have suggested the presently claimed arrangements of any one of independent claims 25, 40 or 46 as follows.

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Contrary to present claim 25, Ress et al. 699 do not disclose and would not have suggested a loose stack of discs, wherein each disc has a reinforcing fiber embedded in a groove with the matrix material surrounding and consolidated around the reinforcing fiber in the groove. According to Ress et al. 699, the consolidation only occurs on the completed stack, not on each individual disc before stacking such discs.

Contrary to present claim 40, Ress et al. 699 do not disclose a plurality of discs in a stack, with a reinforcing fiber embedded in and surrounded by the matrix material that is consolidated around the reinforcing fiber so that the fiber is located between and axially displaced inwardly away from the annular surfaces of the disc. That resulting structure arises from a fabrication process in which a groove deeper than the diameter of the fiber was provided in the matrix material of the disc, the fiber was disposed in the groove, and the disc was consolidated so as to deform the matrix material to close the groove around the fiber. Such a resulting structure is not disclosed and would not have been suggested by Ress et al. 699.

Contrary to present claim 46, Ress et al. 699 do not disclose an alternating intermeshing structure as presently claimed. While Fig. 12 shows a structure with staggered fibers in a matrix, it is not clear if that structure resulted from or includes a stack of discs as presently claimed.

For the above reasons, the Examiner is respectfully requested to withdraw the rejection of claims 25, 27, 31 and 40 to 44 as anticipated by Ress et al. 699.

- 11) Referring to section 10 on pages 4 and 5 of the Office Action, the rejection of claim 29 as obvious over Ress et al. 550 is respectfully traversed. Claim 29 depends from claim 25, which has been discussed above in comparison to Ress et al. 550. Already due to its dependence, claim 29 is patentable. Please withdraw the rejection of claim 29 as obvious.
- 12) Referring to section 11 on page 5 of the Office Action, the rejection of claims 26, 28, 30 and 43 as obvious over Ress et al. 550 in view of either Ress et al. 699 or US Patent 5,337,940 (Woods et al.) is respectfully traversed. Claims 26, 28 and 30 depend from claim 25, and claim 43 depends from claim 40, and these independent parent claims have been discussed above in comparison to Ress et al. 550 and Ress et al. 699. The Examiner has cited Fig. 12 of Ress et al. 699 and Figs. 1C and 2B of Woods et al. for disclosing fiber reinforcement layers staggered at the outer edges of the products. However, Woods et al. do not disclose a true alternating succession of such staggered outer diameters of the fiber-reinforced disc portion. Instead, Fig. 1C discloses an arrangement in which the fiber-reinforced portions become successively larger toward the middle of the thickness of the finished product, in conformance with a tapering outer edge of the product, and Fig. 2B discloses a product in which the fiber-reinforced portions have a successively larger outer diameter from one side toward the other. There is no true alternation of larger and smaller diameters of at least four successive disc layers. Fig. 12 of Ress et al. 699 has been discussed above. While it shows an alternating staggering of the

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reinforcement fibers, it is not clear that this finished consolidated product resulted from a stack of discs arranged as presently claimed. For these reasons, the Examiner is respectfully requested to withdraw the rejection of claims 26, 28, 30 and 43 as obvious over Ress et al. 550 in view of Ress et al. 699 or Woods et al.

- 13) Favorable reconsideration and allowance of the application, including all present claims 25 to 36 and 38 to 46, are respectfully requested.

Respectfully submitted,

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Enclosures:
Transmittal Cover Sheet,
Term Extension Request,
Form PTO-2038

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